

## Physiotherapy treatment of shoulder pain: REHABILITATION PRINCIPLES



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### « Today's Topics .... »

Which exercises/manual techniques to  
prescribe for

- Rotator cuff pathology
- Instability
- GIRD
- Scapular dyskinesis

Kinetic chain approach in shoulder rehab

## Rehabilitation of rotator cuff dysfunction

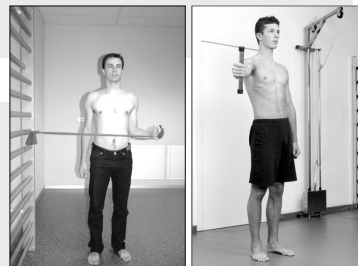
1. **Strengthening** exercises for the cuff: which exercises?
2. How can we increase **motor control** in the RC?
3. **Eccentric** exercises: how can we focus on eccentric phase? training intensity?
4. **Scientific evidence?**

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## 1. Which exercises activate rotator cuff muscles?

(Townsend 1991, Reinold 2009, Ganderton S&E 2013)

1. External rotation
2. Full can
3. Horizontal abduction with external rotation
4. Push-up plus



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## 1. Which exercises activate rotator cuff muscles?

Werner JSES 2006: ER vs IR regarding Subacromial pressure? **ER decreases subacromial pressure** compared to rest, IR increases subacromial pressure.

Boettcher et al. Med Sci Sports Exc 2009: **ER and prone ER exercises** are more valid than the "can" and prone elevation exercises for **supraspinatus** strengthening

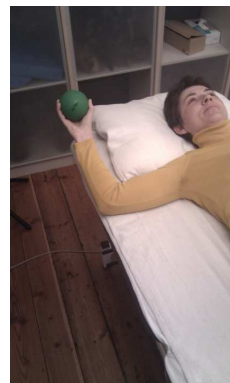
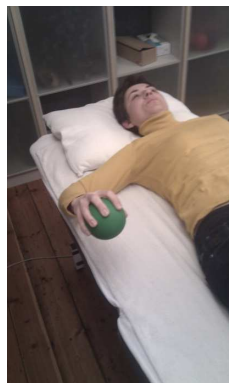
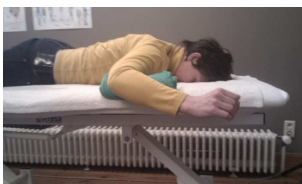
Ganderton S&E 2013: **subscap** only activated when humerus is moved posterior to joint axis and subscap is required to act as a joint stabilizer to control ant translation

Herrington JEK 2015, Uhl JOSPT 2003: **one-handed push-up** increases IS activity

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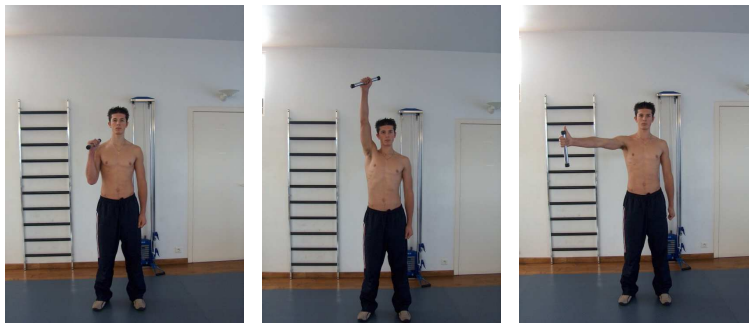
## 2. How increase control in the rotator cuff?

(Anju Jaggi London 2011, Karen Ginn, WCPT 2015, Clark NC Man ther 2015 )



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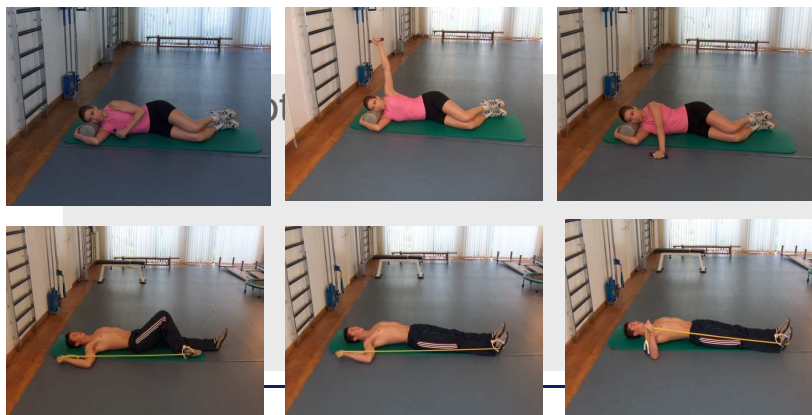
### 3. Eccentric exercises



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(Cools & Walravens 2007, Maenhout et al. KSSTA 2012)

### 3. Eccentric exercises





### 3. Eccentric exercises: intensity and reps? 3x15, 2x/day, discomfort after exercises, min 6w, pain-monitoring model

Key Surg Sports Traumatol Rehabil  
DOI 10.1007/s00381-012-2012-8

**SHOULDER**

**Does adding heavy load eccentric training to rehabilitation of patients with unilateral subacromial impingement result in better outcome? A randomized, clinical trial**

Amelies G. Maenhout · Niek S. Mahieu ·  
Martine De Maessck · Lieven F. De Wilde ·  
Ann M. Cools



Maenhout et al. 2012 (KSSTA): **RCT** sign increase in **RC strength** after eccentric training program, full can exc, however no differences on function and pain.

Holmgren et al. BMJ 2012: RCT: specific exercise program (ecc + scapular exercises) **reduces the need for surgery**

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### 4. Scientific evidence?

Kuhn JSES 2009, Gebremariam BJSM 2013, VD Dolder BJSM 2014, Littlewood S&E 2013, Braun Phys Ther Rev 2013, Voogt Man Ther 2014, Desjardins JOSPT 2015, Abdulla Man Ther 2015, Dong 2015, Littlewood 2015, Desmeules JOccHealth 2016, Ortega-Castillo JSMS 2016... (systematic reviews)

- **Exercise** improves function and pain
- **“Manual Therapy”** as add-on is effective for pain and ROM, not function  
(Manual Therapy = manipulation, mobilization, spine, scapula & shoulder, MWM, transverse frictions....)
- Supervised exercise = **home program**

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## 4. Scientific evidence - continued

- No additional value for SA **corticosteroid injection** compared to physiotherapy in 1y follow-up (only short-term pain reduction)
- **Thoracic manipulations** have “limited” value for pain, perceived function and ROM (Michener Man Ther 2015, Kardouni Man Ther 2015, Riley Man Ther 2015)
- **Ischemic Compression & Dry Needling** recommended in case of trigger points (syst review Cagnie AM J Phys Med Rehab 2015)
- Individualized exercises lead to **lower costs** compared to individualized manual therapy (for same amount of physio visits 2x/w)
- **Ecc vs conc vs isom?** No consensus (Ortega-Castillo et al. 2015)
- **Pain vs no pain?** No consensus (Hultenheim 2015, Littlewood 2015)

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## 4. Scientific evidence – surgery vs exercises

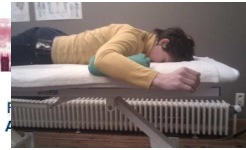
Toliopoulos et al. Clin Rheumatol 2014

### Efficacy of surgery for rotator cuff tendinopathy: a systematic review

Panagiotis Toliopoulos · François Desmeules · Jennifer Boudrcault ·  
Jean-Sébastien Roy · Pierre Frémiot · Jay C. MacDermid · Clement E. Dionne

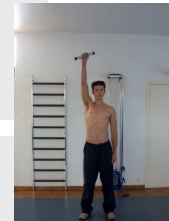
treatment of RC tendinopathy. Based on low- to moderate-quality evidence, acromioplasty, be it open or arthroscopic, is no more effective than exercises for the treatment of RC tendinopathy. Low-grade evidence also suggests that arthroscopic acromioplasty may yield better

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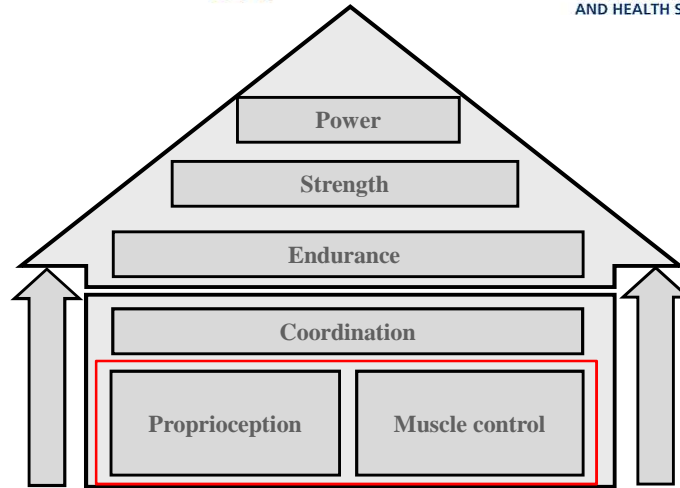
## Practice

1. Total rotation
2. Eccentric exercise SS – 123 exc
3. Eccentric exercise IS – 123 exc
4. Eccentric exercise ER in ABER (abd-ext rot)



## Rehabilitation of shoulder instability

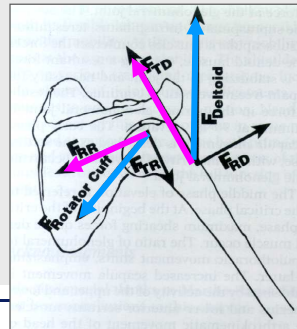
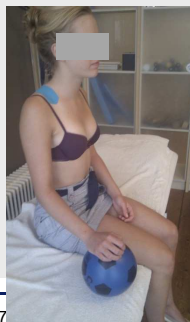
1. How can we exercise **local co-contraction**?
2. General **guidelines** TUBS vs AMBRI?
3. **Open chain exercises**: from RC training to throwing?
4. **Sportspecific** exercises?
5. Algorithm for progression in **closed chain exercises**?



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**CONSCIOUS MUSCLE CONTROL:**

- Rotator cuff (TUBS + AIOS)
  - Deltoid (AMBRI/MDI)
- (Wilk et al. 2002, Barden 2005)



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## Strategy in 3 steps

1. Contraction (no control yet)
2. From contraction to control
3. Control (co-contraction)

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## Deltoid co-contraction in closed chain



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## TUBS/AIOS versus AMBRI

### TUBS/AIOS

Rotator cuff  
From CKC to OKC  
Stretching posterior  
capsule (GIRD)

### AMBRI

Deltoid (ant-post)  
A lot of CKC  
No stretching

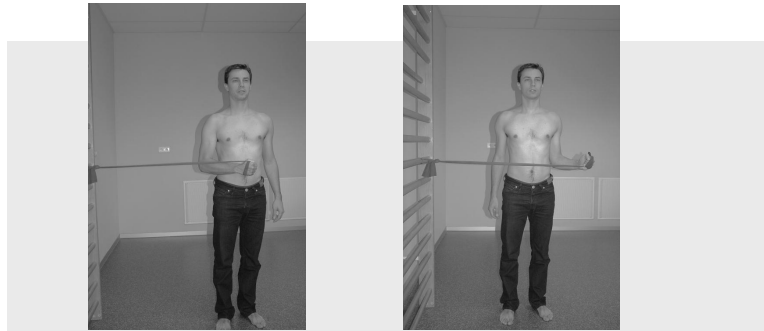
(OKC = Open Kinetic Chain exercises, CKC = Closed Kinetic Chain exercises)

Progression  
in exercise modalities:

Resistance ↑ (50 → 80%)  
Functional relevance ↑

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## From basic RC training to functional movements



IR

ER

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## “Throwing program”

- TUBS and AIOS
- Not for MDI as basic program, only when overhead sports is the goal
- Everybody who wants to throw a ball... (also non-athletic population)
- Not only for instability patients, also cuff problems, SLAP, scapular dyskinesis, post op.....)

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## Functional diagonal limited load in ABER



IR



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## Functional diagonal high load in ABER



IR



ER Rehab A Cools 2017

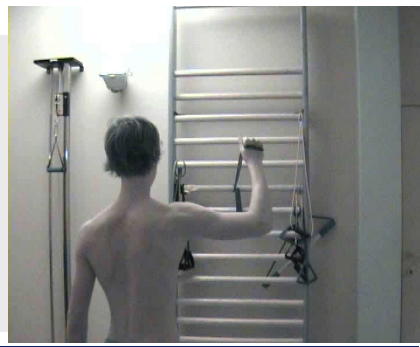




## Plyometrics in ABER



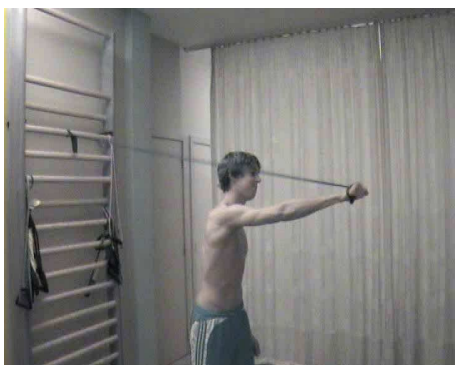
IR



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## Acceleration & deceleration phase throwing



IR



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In summary:  
Internal Rotation progression:

1. IR in neutral
2. Diagonal with limited ABER load
3. Diagonal with high ABER load
4. Plyometrics in ABER
5. Throwing against resistance

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In summary:  
External Rotation progression:

1. ER in neutral
2. Diagonal with limited ABER load
3. Diagonal with high ABER load
4. Plyometrics in ABER
5. Eccentric loading external rotators during deceleration

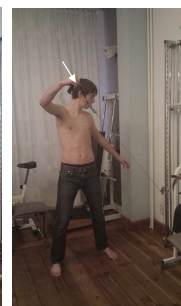
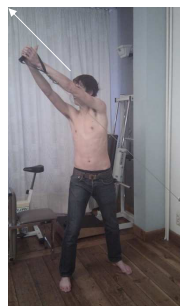


## Advanced program for “throwers”

- Eccentric high load exercises for posterior cuff
- Plyometrics using plyoball, flexbar, Xco...
- Sportspecific positions
- Attention to the kinetic chain

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## Eccentric diagonals

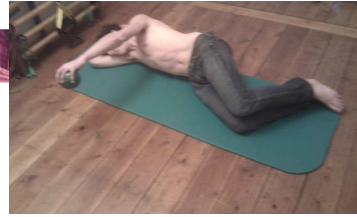
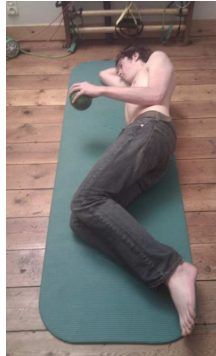


Trunk rotation sign increases scapular external rotation and posterior tilt, increases LT activation, and decreases UT/LT ratio  
(Yamauchi JSES 2014)

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## Plyometrics IR & ER

(Ellenbecker & Cools 2010)



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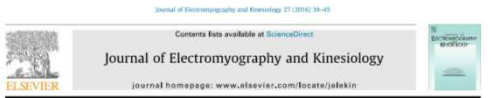
## Plyometrics IR & ER in ABER



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### Role of SPORT SPECIFIC PLYOMETRIC tasks on scapular muscle recruitment (Maenhout et al. JEK 2015)



Scapular muscle activity in a variety of plyometric exercises  
Maenhout Annelies<sup>1,2</sup>, Benzoor Maya<sup>3,4</sup>, Werin Maria<sup>4</sup>, Cools Ann<sup>2</sup>

<sup>1</sup>Ghent University, Department of Rehabilitation Medicine and Physiotherapy, Campus Houtven, Dr. Plehousen 141, 9000 Ghent, Belgium  
<sup>2</sup>Belgian Center for Sports Medicine and Research at the Hospital Herestraat 49/52, Ghent  
<sup>3</sup>Department of Physical Therapy, University of Health, Science and Health 370, Miami Corral, Health 34863K, Brazil



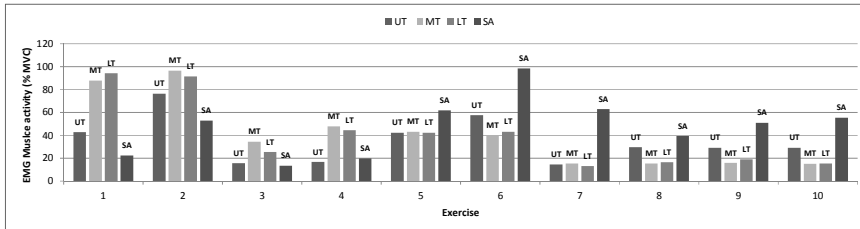
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(Maenhout et al. JEK 2015)

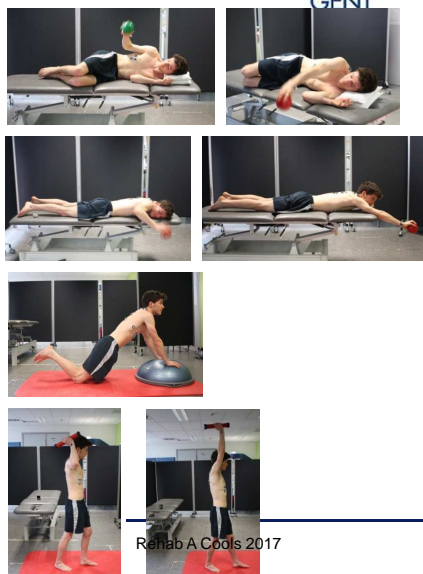


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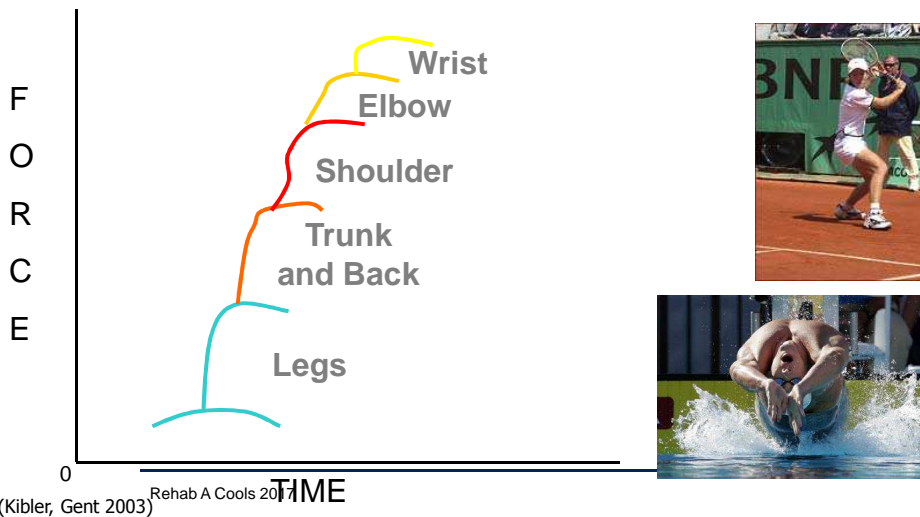
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Goal of the exercise:

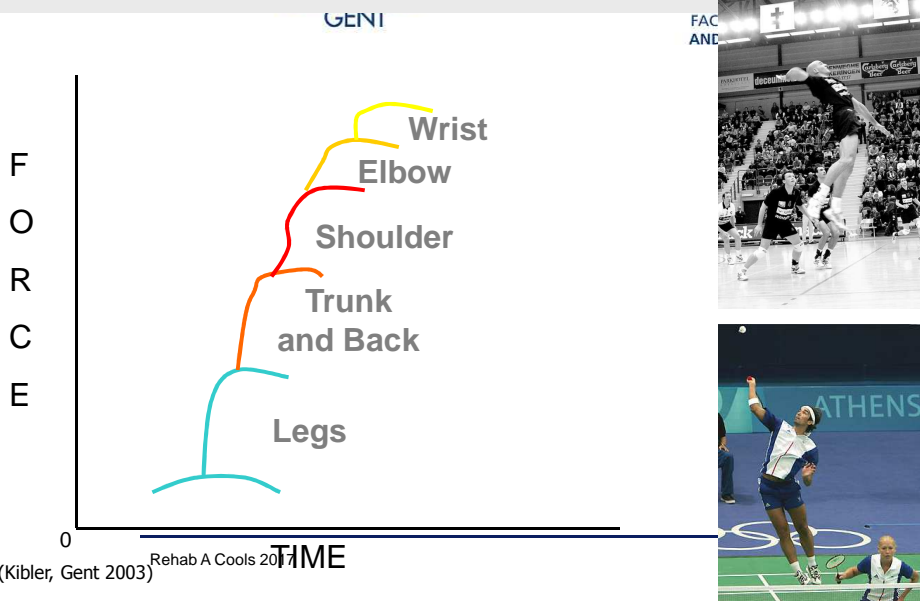
1. UT ↓
2. MT & LT ↑
3. SA ↑ and UT ↓
4. Overall scap muscles ↑



# Thrower's program: Kinetic Chain



# Thrower's program: Kinetic Chain







# “Thrower’s program” sportspecific: kinetic chain



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# Integration Kinetic Chain into open chain shoulder rehabilitation exercises



Contents lists available at SciVerse ScienceDirect  
**Journal of Science and Medicine in Sport**  
journal homepage: [www.elsevier.com/locate/jaams](http://www.elsevier.com/locate/jaams)



Original research

Kinetic chain influences on upper and lower trapezius muscle activation during eight variations of a scapular retraction exercise in overhead athletes

Kristof De Mey<sup>a,\*</sup>, Lieven Danneels<sup>a</sup>, Barbara Cagnie<sup>a</sup>, Van den Bosch Lotte<sup>b</sup>, Flier Johan<sup>b</sup>, Ann M. Cools<sup>a</sup>

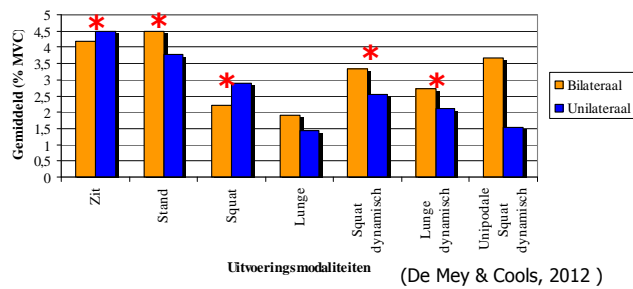


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Results: EMG activity scapular muscles: unilateral squat versus other exercise modalities



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\* = significant main effect "exercise"

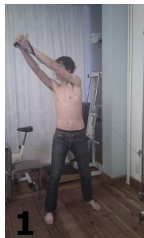
Sportspecific program: swimming



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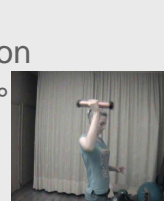
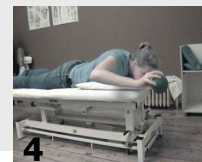


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### Practice

1. Eccentric ER diagonal
2. Plyoball neutral position
3. Plyoball 90° forw flex
4. Plyoball 90°-90°
5. Plyoball full elevation
6. Xco/flexbar 90°-90° and full elevation
7. W-V ex swissball



## TUBS/AIOS versus AMBRI

### TUBS/AIOS

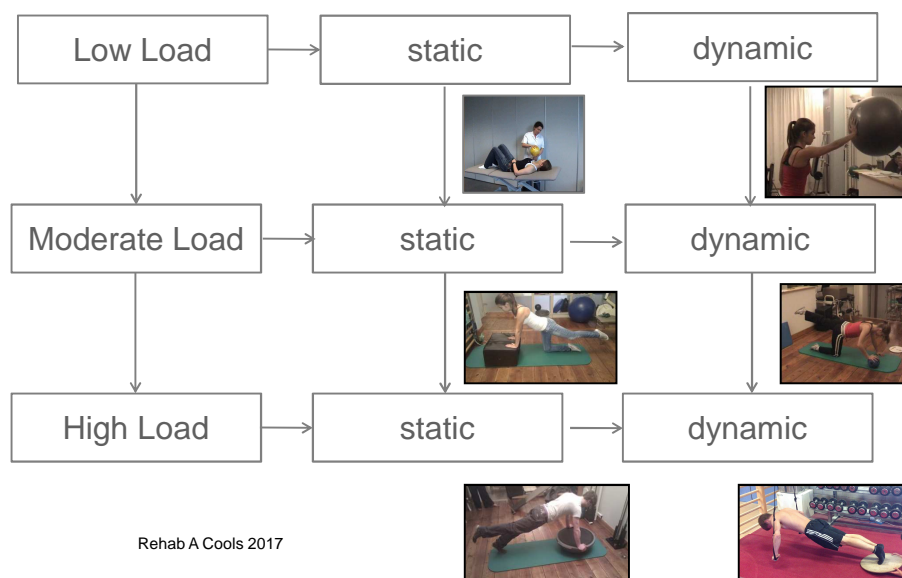
Rotator cuff  
From **CKC** to OKC  
Stretching posterior capsule (GIRD)

### AMBRI

Deltoid (ant-post)  
A lot of **CKC**  
No stretching

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## General Guidelines AMBRI/MDI



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## Diagonals in CK exercises

Semi closed chain SA exc  
(elevation)



Semi closed chain trap exc  
(rowing)



Case: gymnast with chronic shoulder pain based on instability

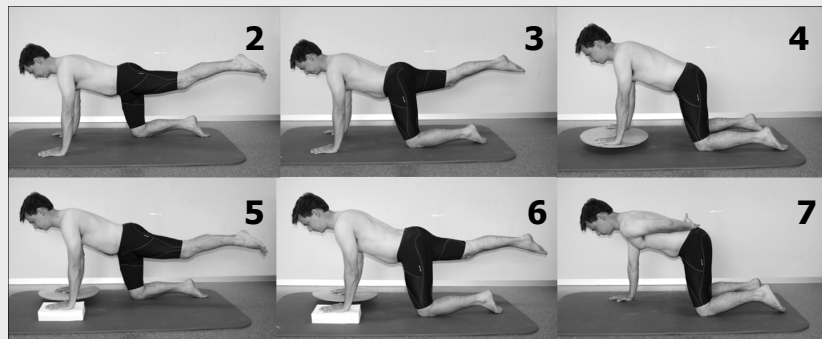
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Original article

Electromyographic analysis of knee push up plus variations: what is the influence of the kinetic chain on scapular muscle activity?

A Maenhout,<sup>1</sup> K Van Praet,<sup>2</sup> L Pizzi,<sup>3</sup> M Van Herzele,<sup>1</sup> A Cools<sup>1</sup>

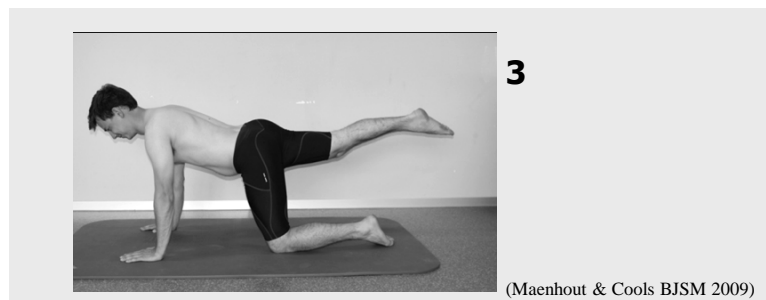
6 modalities of the push-up plus exercise (N=32)



(Maenhout & Cools BJSM 2009)

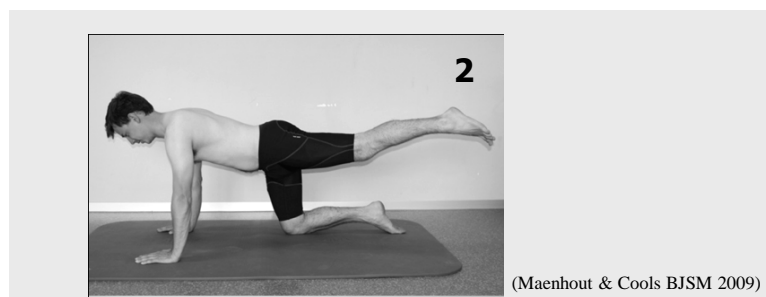
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Highest **SA** activity (44%MVC) en best UT/SA ratio (0.40) when **ipsilateral** leg is extended



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Highest activity in **MT & LT**, when **contralateral** leg is extended (LT=20%MVC)



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## Stretching and Mobilisation techniques in the rehabilitation of G.I.R.D.

1. Angular stretching
  - a. Internal rotation: « sleeper's stretch »
  - b. Horizontal adduction: « cross-body stretch »
2. Translation mobilisations in end-range (dorsal glides)
  - a. Internal rotation
  - b. Horizontal adduction
3. Mobilization with movement – dorsal glides
  1. External rotation
  2. Forward flexion
  3. Abduction

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(Cools et al. BJSM 2008, Ellenbecker & Cools BJSM 2010, Wilk JOSPT 2009, Cools et S&E 2011)

## Sleeper's stretch: ask for pain ant vs posterior



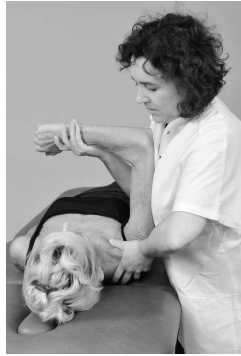
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(Cools et al. BJSM 2008, Ellenbecker & Cools BJSM 2010, Wilk JOSPT 2009)





## Sleeper's stretch supine + caudal glide or Hold relax



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(John Borstad, JOSPT 2011)



## Cross Body Stretch: Work together with the patient



(Cools BJSM 2006; Sahrmh Arch Phys Med Rehab 2015)





## Reversed Cross Body Stretch + Hold Relax



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(Cools BSW 2006, Sarahh Artch Phys Med Rehab 2015)



## Home Program



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## Mobilisation: dorsal glide in endrange



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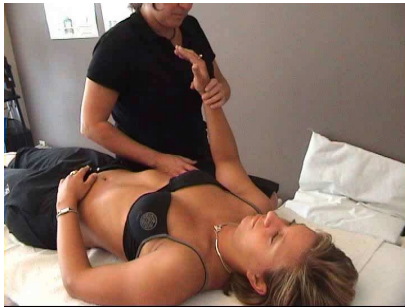
## Dorsal glides in moderate internal rotation



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## Mobilisation with movement: ER + dorsal glide



(pictures in handout are start of movie)

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## Mobilisation with movement: forward flexion + dorsal glide



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## Mobilisation with movement: abduction + dorsal glide



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## Stretching posterior structures?

Mc Clure JOSPT 2005: improvement IR ROM after 4-weeks **home stretching** program, cross body stretch & sleeper's stretch

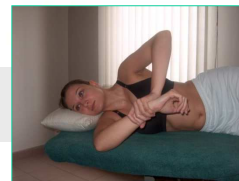
Manske Sports Health 2010: angular stretching (home program) + **joint mobilisation** (dorsal glide) slightly better than stretching only.

Tyler AJSM 2010; Cools S&E 2011: ROM improvement is related to **symptom** relief.

Cools S&E2011: equal results from **angular stretch versus dorsal glide**

Maenhout AJSM 2012: stretching increases the size of the **subacromial space**

Konrad Clin Biomech 2014: **Muscular release** rather than structural changes in muscle tendon unit.





## Joint mobilization and MWM for glenohumeral stiffness?

(Lewis Man Ther 2015, Noten et al. Syst Review 2016)

- stretching *specific* part of the capsule **only in endrange** (Hsu et al. 2001, Yang et al. 2007)
- Better results for **high-grade** versus low-grade (Vermeulen et al. 2000)
- both caudal and dorsal glides (**indirect mobilisations**) improve abduction ROM (Hsu et al. 2002)
- **MWM superior effects** when added to passive mobilization (Yang et al. 2007, Doner et al. 2013)
- **Dorsal glide** is superior to anterior glide in external rotation ROM (Johnsson JOSPT 2007)

7

## Rehabilitation of scapular dyskinesia

1. Summary of factors determining scapular dyskinesia?
2. Treatment of flexibility deficits (pect minor)
3. Treatment of muscle performance deficits
  1. Neuromuscular control (scapular positioning)
  2. Strength deficits and intermuscular balance

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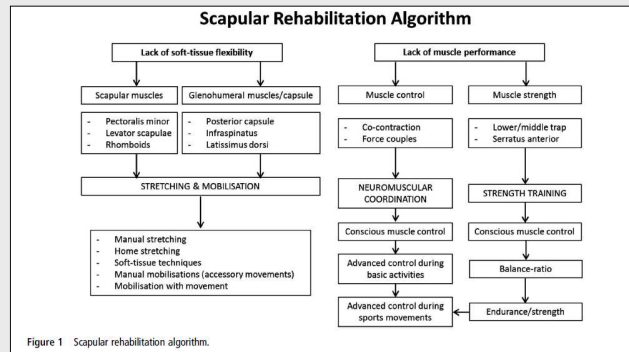




# Rehabilitation of scapular dyskinesia: from the office worker to the elite overhead athlete

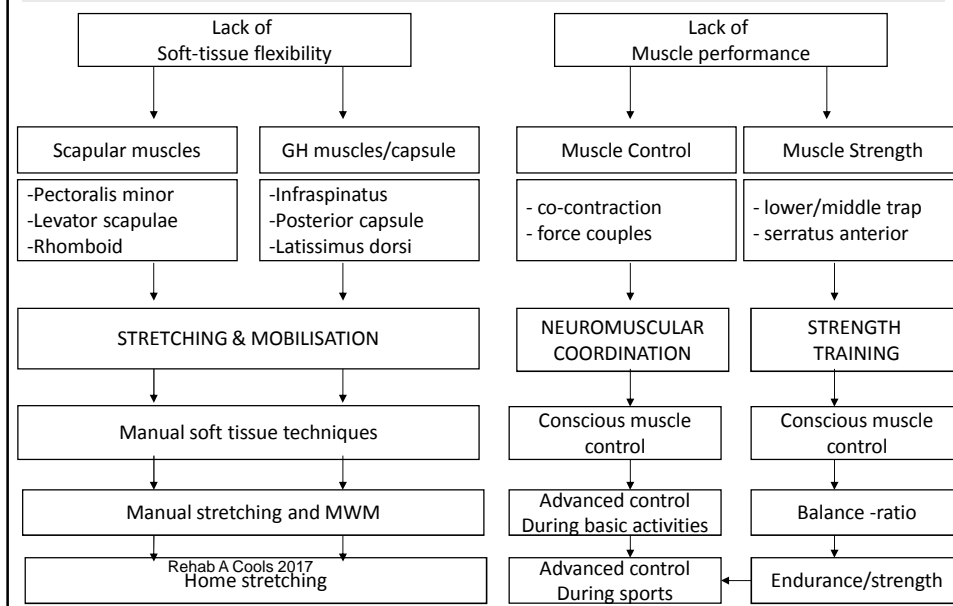
Ann M J Cools, Filip Struyf, Kristof De Mey, et al.

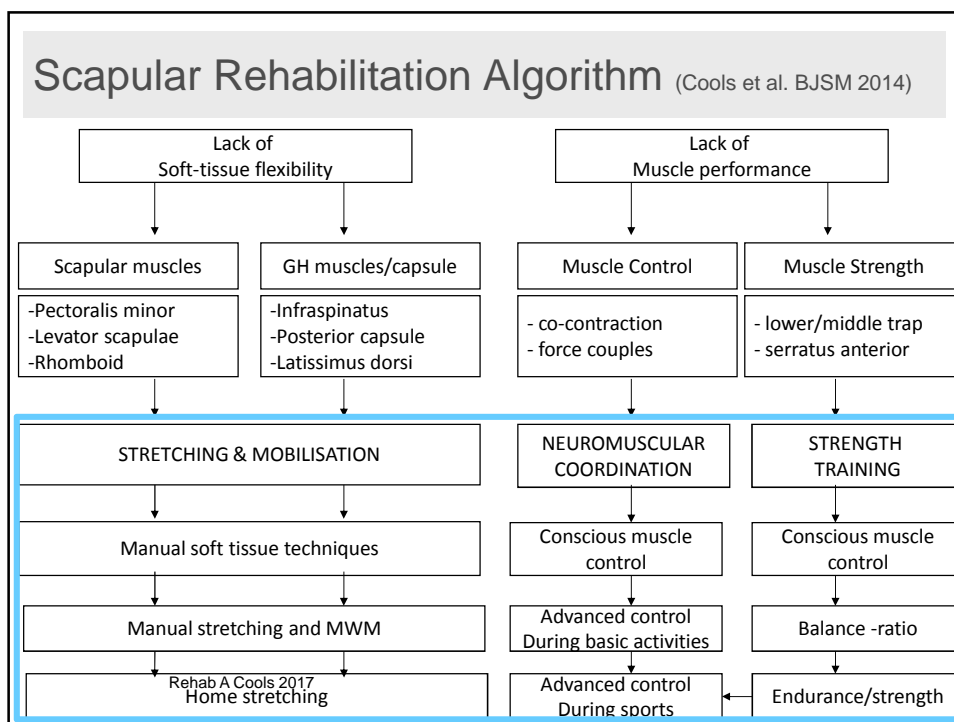
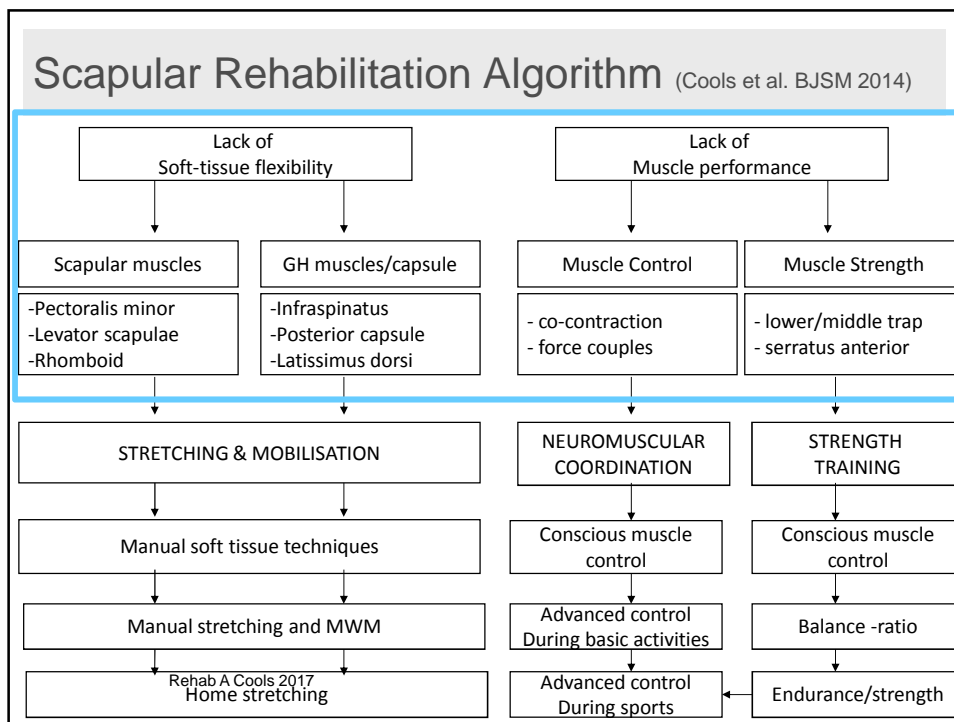
Br J Sports Med published online May 18, 2013  
doi: 10.1136/bjsports-2013-092148

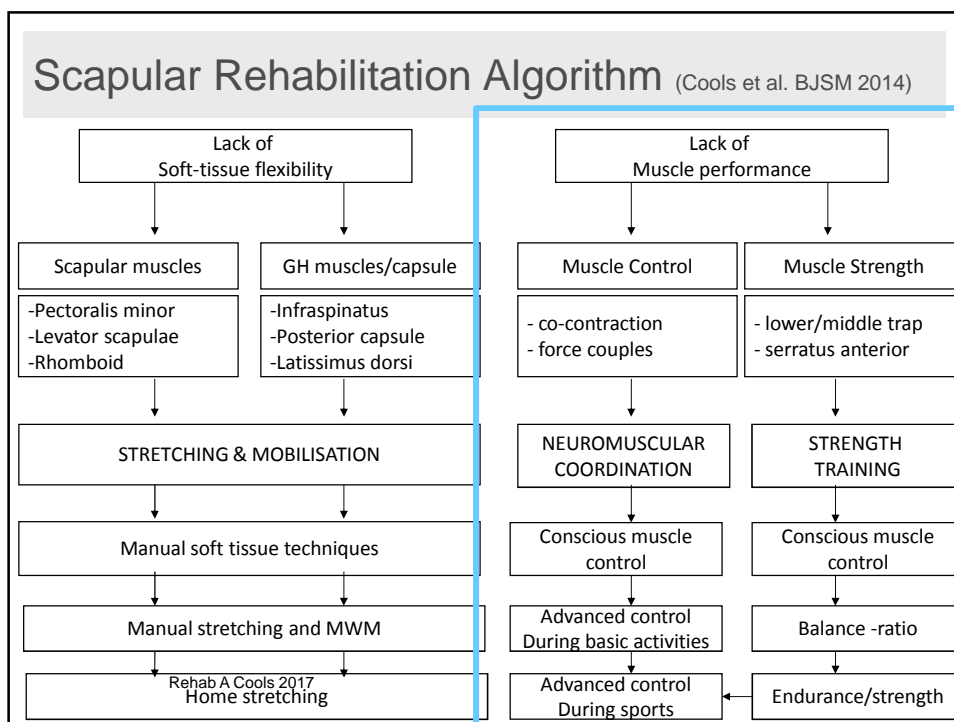
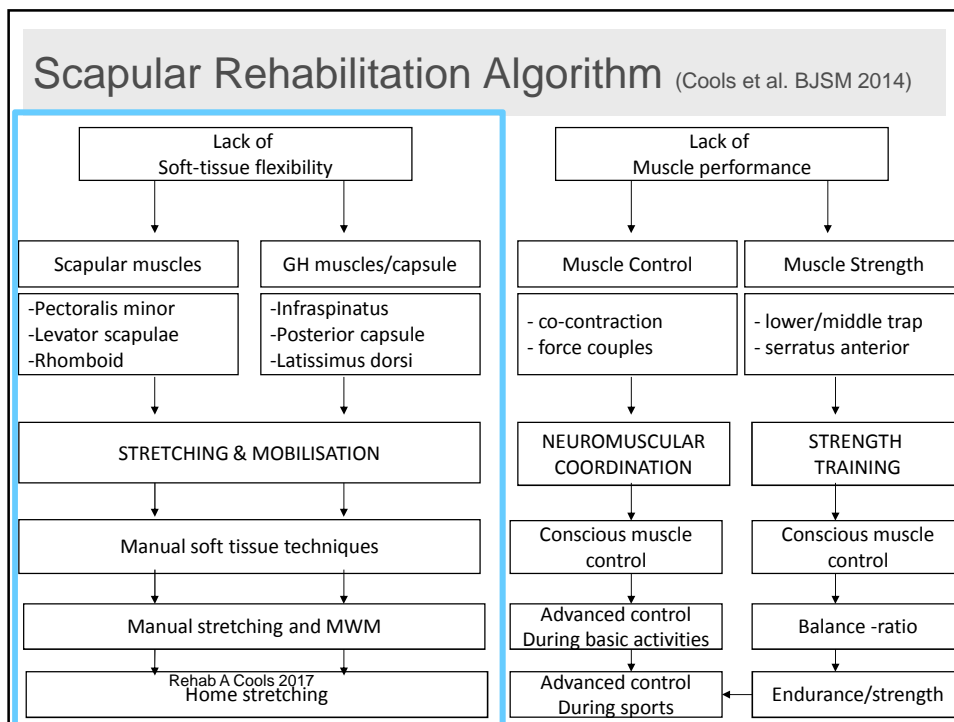


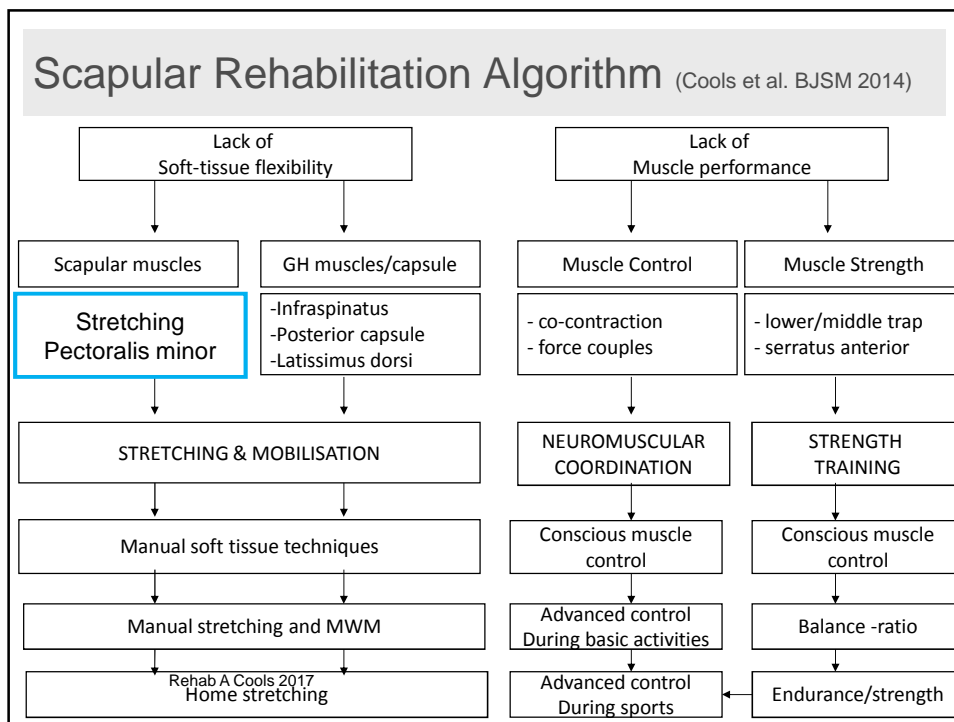
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## Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)












### Stretching pectoralis minor: literature

Borstad et al. JOSPT 2005: short PM induces anterior tilt and downward rotation (= impingement patients)

Cools & Johansson BJSM 2010: significant decrease PM length in elite junior (11-17yr) tennis players

Reeser PM&R 2010: tight PM is associated with history of shoulder pain in volleyball players

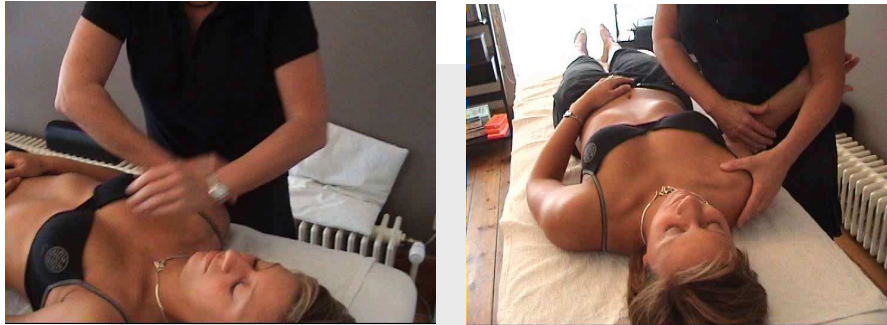
Borstad et al. JSES 2006: unilateral self stretch (in 90° ABER) best results, however...





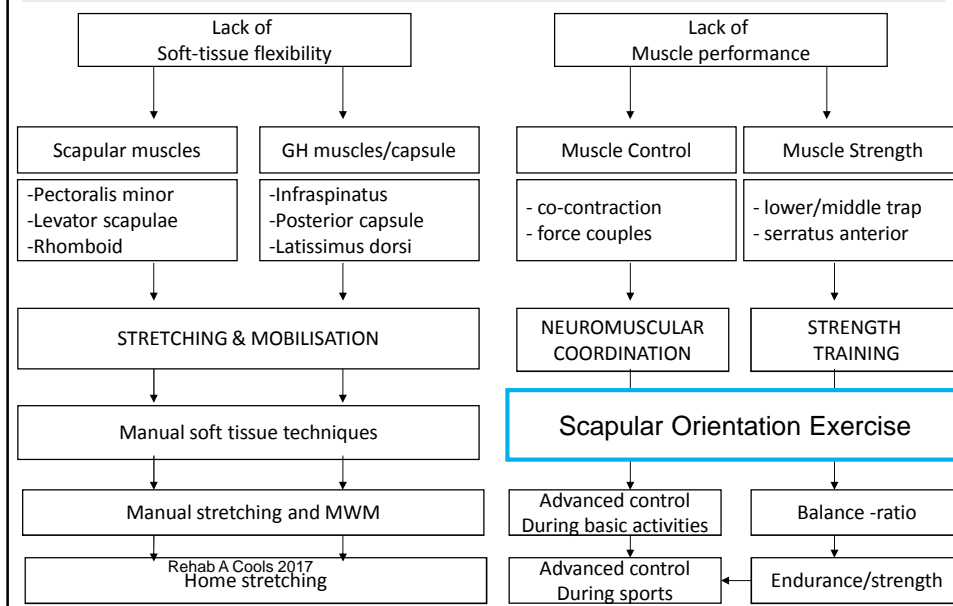

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## Stretching pectoralis minor: clinical experience



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## Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)



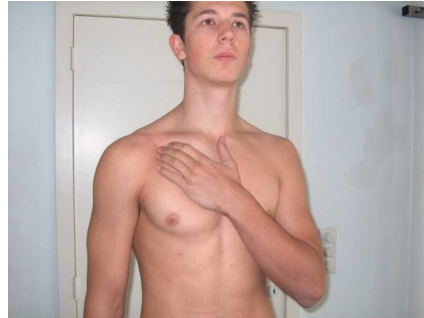


## Correction of scapular position: literature

### Scapular Orientation Exercise

- Scapular upward rotation and posterior tilting
- Increased scapular muscle activity

(Motttram et al. Man Ther 2009)



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## Correction of scapular position: clinical experience



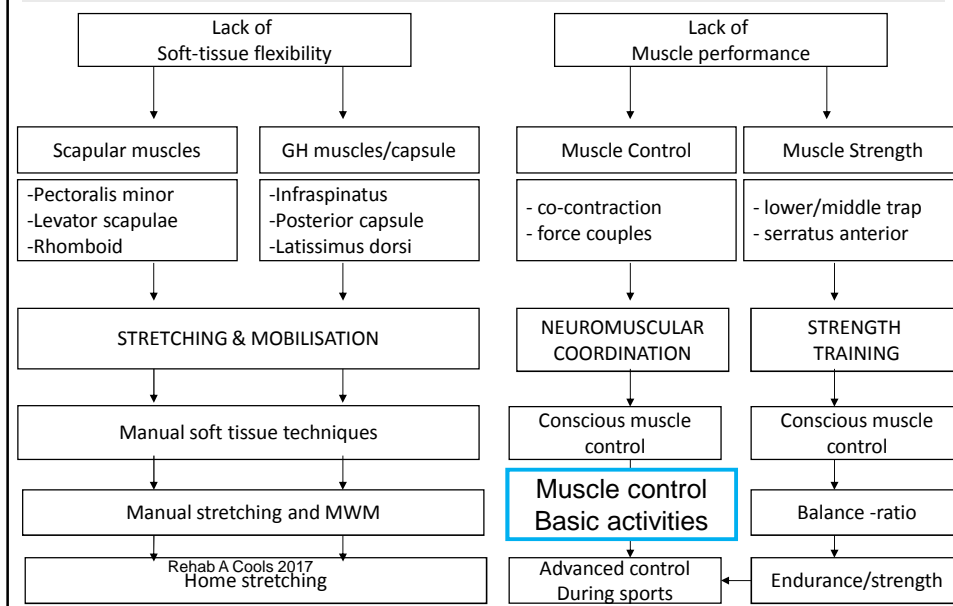
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## Correction of scapular position: clinical experience



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## Scapular Rehabilitation Algorithm (Cools et al. BJSM 2014)



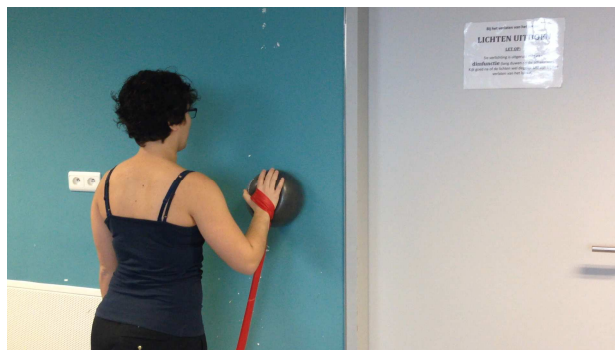
Purpose: increase scapular dynamic control during various exercises and movements: some examples...



(Kibler 2008, Uhl 2010, Johansson 2012, Cools 2013)

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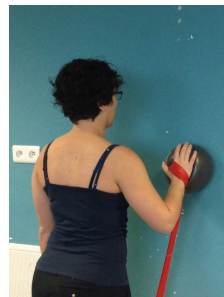
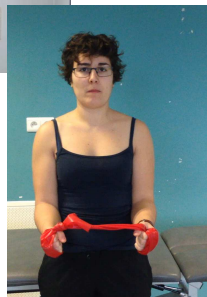
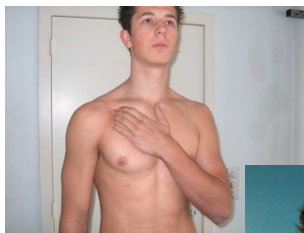
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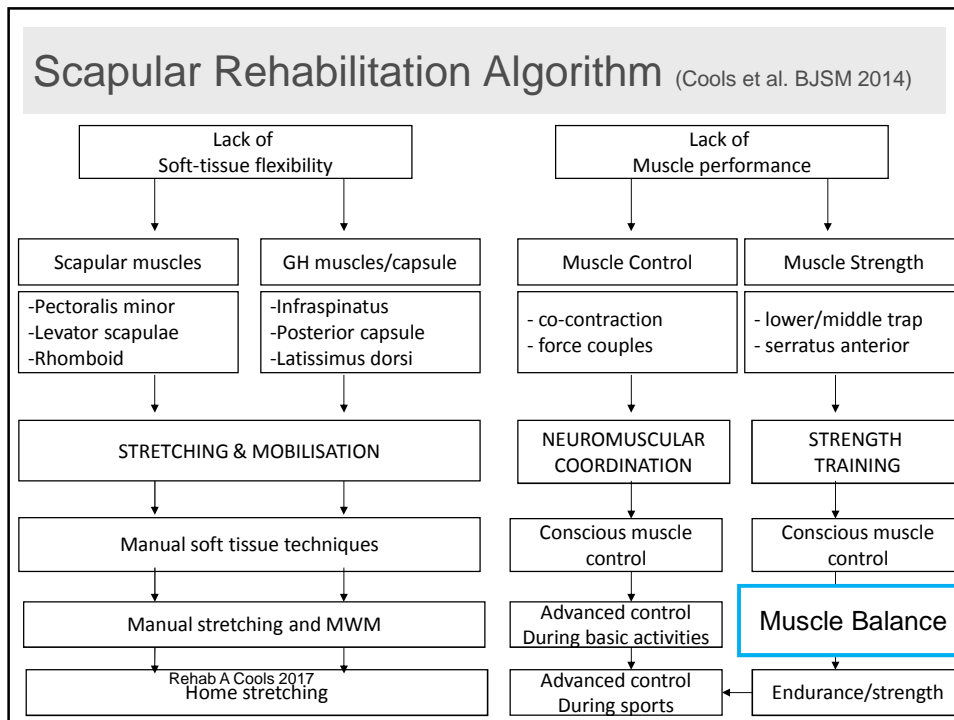
(Kibler 2008, Uhl 2010, Johansson 2012, Cools 2013)




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## PRACTICE



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### Rehabilitation muscle balance UT/SA

1. Elbow push-up
2. Serratus punch lying on the back
3. Serratus punch in closed chain

(Ludewig et.al. 2004)



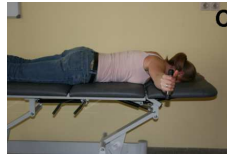


## Rehabilitation muscle balance UT/MT & UT/LT

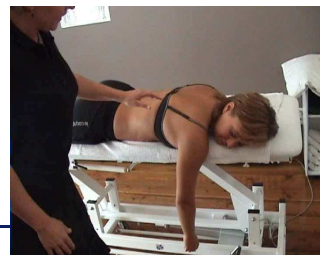
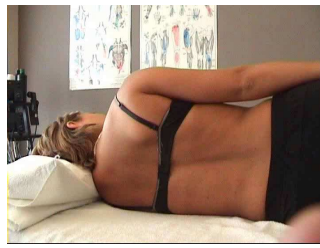
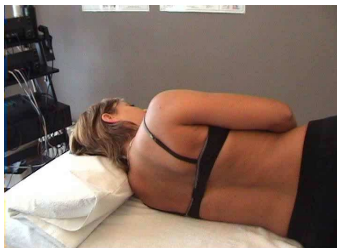


### Rehabilitation of Scapular Muscle Balance Which Exercises to Prescribe?

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1. ER side
2. Forw Flex side
3. HA+ER prone
4. Ext prone



## Scientific evidence

- scapular exercises promote **early activation of LT** and late activation of UT (De Mey et al. JOSPT 2009)
- **Pre-setting** during exercises increases muscle activity in trapezius (De Mey et al. JOSPT 2012)
- scapular program (12w/6mo) increases scapular and ER strength **healthy** participants (Vandevelde et al. JAT 2010, Merolla et al. JAT 2010)
- scapular exercises **normalize EMG activity in scapular muscles** during functional movement (De Mey et al. AJSM 2012)
- Scapula focussed approach **benefit** over general approach in **early rehab** (6w), but not on longer term. Are differences clinically relevant? (Bury et al. Man Ther 2016 – syst rev)

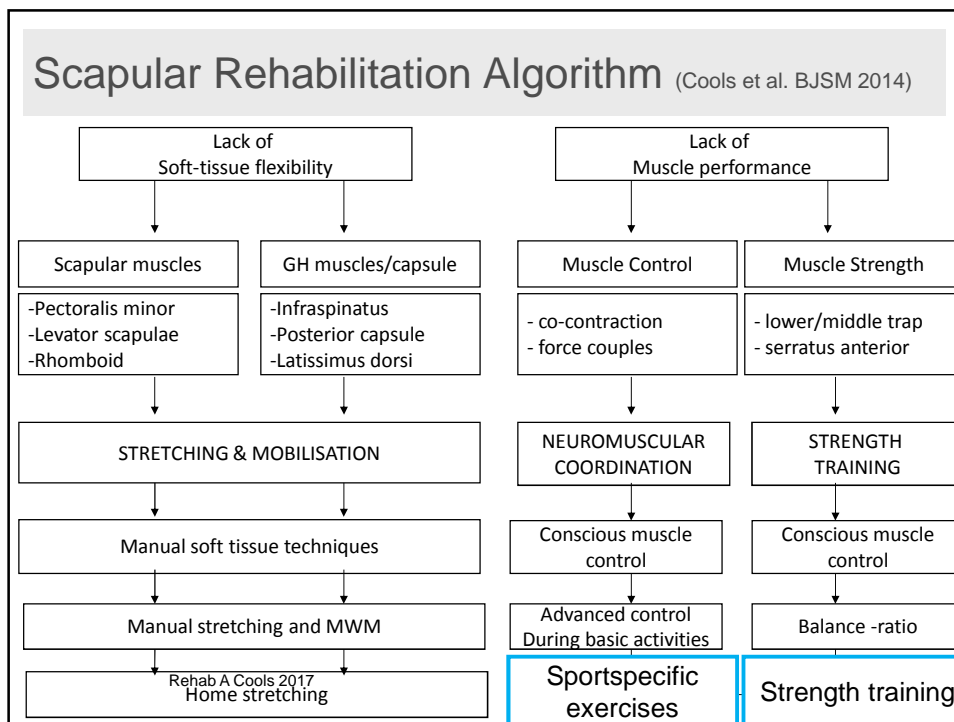
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## UT/SA



## UT/MT & UT/LT









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## Case-presentation

Young elite gymnast, 12 years old, 34 hours/week training

Shoulder pain during sport for 6 months

4 months physiotherapy, scapular training, muscle control...

Imaging and EMG negative

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## Case-presentation

No “conscious” trapezius training

Try to optimise global and subconscious muscle control?

A lot of closed kinetic chain (cfr sports activity: pain during weight bearing on upper limb)

**Looking for “ appropriate” exercises.....**

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